ORIGINAL ARTICLE

Metabolic syndrome in newly diagnosed type 2 diabetes mellitus using NCEP-ATP III, the Nnewi experience

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Abstract

Background and Objectives: Type 2 diabetes is becoming epidemic and several studies have shown that diabetes is associated with increased co-morbidities and impaired functional health in the general adult population. Type 2 diabetes is one of the co-morbidities associated with metabolic syndrome that carries with it increased risk of cardiovascular disease and death. The purpose of this study is therefore to determine the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus subjects seen at Nnewi South East Nigeria.

Design and Setting: This is a cross-sectional study in newly diagnosed diabetics attending a private hospital-Hope Specialist Hospital, Nnewi.

Materials and Methods: One hundred and eighteen (118) newly diagnosed diabetic patients were recruited into the study consisting of those who on routine screening were found to have elevated blood glucose or were symptomatic of the disease and presented for treatment.

Statistical Analysis: Statistical analysis was carried out using SPSS version 13. Student's *t*-test was used for continuous variables, and a χ^2 test was used for categorical variables. In the analyses a *P*- value of <0.05 was considered statistically significant.

Results: Of the 118 subjects, 25 were removed from the study because their samples were lost as a result of prolonged power outage leaving 93 subjects consisting of 47 males and 46 females. The mean (SD) and the range of age was 55.27 (12.55) years, 24-84 years; SBP 153.52 (29.83) mmHg,100-230 mmHg; DBP 94.23 (15.42) mmHg, 60-140 mmHg; TC 5.17 (1.4) mmol/L, 2.0-11.12 mmol/L; LDL-C 2.06 (1.55) mmol/L, 0.1-9.4 mmol/L; HDL-C 1.28 (0.48) mmol/L, 0.15-2.8 mmol/L; TG 1.75 (0.85) mmol/L, 0.50-5.0 mmol/L; BMI 30.30 (6.23) kg/m^2, 17.84-49.12 kg/m^2; and WC of the general population mean (SD) 96.86 (7.16) cm, range 84-112 cm; for men 101.40 (3.88) cm, range 85-108 cm and for women 92.22 (6.77) cm, 84-112 cm. Metabolic syndrome was found in 62 (66.7%) subjects of which 26 (41.9%) were males and 36 (58.1%) were females ($P < 0.019$). The prevalence of different components of metabolic syndrome was as follows: hypertension was found in 75 (80.6%): 37 males and 38 females ($P = 0.635$), dyslipidemia in 31 (60.8%): 19 males and 12 females ($P = 0.572$). Obesity was found in 23 (45.1%): 8 males and 15 females ($P < 0.014$)**.** Of the study subjects 33 had hypertension prior to the diagnosis of diabetes mellitus (DM). Seventeen males had hypertriglyceridemia against 11 females ($P = 0.357$). Equal number of males and females (11 each) had low HDL--C ($P = 0.603$).

Conclusion: The study shows that metabolic syndrome is highly prevalent in newly diagnosed type 2 diabetes patients and the most common risk factor is hypertension.

Key words: Blood sugar, metabolic syndrome, newly diagnosed type 2 diabetes, prevalence

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Introduction

Metabolic syndrome (MetS) is a widely prevalent and multi-factorial disorder. The syndrome has been given several names including the metabolic syndrome, the insulin resistance syndrome, the plurimetabolic syndrome, and the deadly quartet. Metabolic syndrome was first defined by Kylin, a Swedish Physician in 1923 as a clustering of hypertension, hyperglycemia, and gout.[1] It is estimated that around a quarter of the world's adult population have MetS and they are twice as likely to die from and three times as likely to have a heart attack or stroke compared with people without the syndrome.[2] The United States Census Department has given an estimate of approximately 25% among its general population.[3]

With the formulation of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (NCEP-ATP III) guidelines, some uniformity and standardization occurred in the definition of the metabolic syndrome and this has been very useful for epidemiological purposes. Various criteria have been proposed by WHO,[4] NCEP-ATP III,[5] the European Group for the study of Insulin Resistance,[6] and the International Diabetes Federation (IDF).[7] There are essential components that are common to all definitions such as glucose intolerance, obesity, hypertension, and dyslipidemia though the exact criteria differ among definitions. Taken individually, each component of the MetS is a well- established risk factor for atherosclerotic cardiovascular disease (ASCVD). These factors act synergistically and increase the risk for ASCVD from two to three fold.[8] For subjects without diabetes the need for assessment of insulin resistance by either an oral glucose tolerance test or the hyperinsulinemic-euglycemic clamp implies that the WHO definition is more appropriate for clinical research purposes. In contrast the NCEP-ATP III definition is better suited for clinical practice because it only requires measurement of fasting blood glucose.[9]

Type 2 diabetes is becoming an epidemic world-wide[10] and the prevalence of diabetes in adults was estimated to be 4% in 1995 and it is predicted to rise to 5.4% by the year 2025. It is estimated to increase from 3.9% in 2010 to 4.3% in 2030 in Nigeria.[11] Several studies have demonstrated that diabetes is associated with increased co-morbidities as found in metabolic syndrome and impaired functional health in the general adult population.[12,13] However, several other studies have demonstrated that intensive blood glucose control decreased the risk of complications in patients with type 2 diabetes.[14-16] The prevalence of metabolic syndrome is higher among diabetics than non-diabetics and is reported as 70-80% among Caucasian type 2 diabetics.[17,18] A study conducted in an Indian urban population gave a metabolic syndrome prevalence of 77.2% among type-2 diabetics.[19]

Not many studies have looked at the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes in Nigeria as the bulk of studies have been on established type 2 diabetes. The purpose of this study is therefore to determine the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus subjects.

Materials and Methods

One hundred and eighteen (118) newly diagnosed diabetic patients were recruited into the study from a private hospital-Hope Specialist Hospital, Nnewi. These were made up of those who on routine screening were found to have elevated blood glucose or were symptomatic of the disease and presented for treatment

Excluded from the study were those who had been previously diagnosed to have diabetes whether they have been receiving treatment or not, those <30 years of age, those with renal failure and ascites due to any cause.

Informed consent was obtained after fully explaining the procedure and objective of the study.

The first twenty five samples were lost as a result of prolonged power outage during storage prior to analysis leaving 93 for the study.

Seven measures representing the MetS were obtained, including fasting blood glucose (FBG), waist circumference, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), systolic blood pressure (SBP), and diastolic blood pressure (DBP), and additionally body mass index (BMI). At the baseline examination, blood samples were taken after minimum 6-hours overnight fast. Serum was separated on-site within 30 minutes of venipuncture, stored at 4°C, and analyzed within 24 hours of venipuncture. Determination of routine biochemical parameters was performed with standard techniques by using an autoanalyzer. Values for each person were calculated by Friedewald's formula and LDL-C values >10.36 mmol/l were not taken into account.

Waist circumference was measured in the horizontal plane midway between the inferior margin of the ribs and the superior border of the iliac crest with the subject standing erect, arms by the sides but away from the trunk, abdomen, and breathing normally. A non-stretchable tape measure graduated in centimeters was used for the measurement. The plane of the tape was parallel to the floor and the tape was snug, but did not compress the skin. The measurements were recorded to the nearest 0.5 cm and taken at the end of normal inspiration.

BMI was calculated as the ratio of body weight to square of body height (kg/m^2). Obesity was defined based on

BMI ≥30 kg/m^2. Height measurement was done using a stadiometer and the subject stood barefoot with feet together, arms by the sides, and in a fully erect posture on the stadiometer foot-rest. The movable headboard was then placed on top of the subject's head height is read off to the nearest 0.01 m. Weight was measured using a weighing scale and the subject wearing only light clothing and standing at the centre of the weighing scale and weight was read off to the nearest 0.5 kg.

Blood pressure was calculated as the average of three measurements taken under standardized conditions in a sitting position with a sphygmomanometer and hypertension was defined as ≥130 mmHg systolic blood pressure and ≥85 mmHg diastolic blood pressure according to NCEP-ATP III guideline.[5]

Diabetes mellitus was defined as a fasting blood glucose level ≥ 7 mmol/l.

MetS was defined in this study using the NCEP-ATP III[5] criteria, as any two or more of the following in the presence of diabetes. In other words, in this study involving type 2 DM they would only have two other risk factors to be deemed to suffer from the metabolic syndrome:

(a) WC men > 102 cm, women > 88 cm
(b) Raised triglyceride level ≥1.7 mmol/l
(c) Reduced HDL-C < 1.03 mmol/l (male) or 1.29 mmol/l (female)
(d) Raised blood pressure: systolic BP ≥ 130 mmHg or diastolic BP ≥ 85 mmHg or treatment of previously diagnosed hypertension.

Statistical analysis was carried out using SPSS version 13. Student's *t* test was used for continuous variables, and a χ^2 test was used for categorical variables. In the analyses a *P* value of < 0.05 was considered statistically significant

Result

During the study period 118 newly diagnosed adult type 2 diabetes mellitus patients were seen. Of these 25 were removed from the study because the samples were lost as a result of prolonged power outage prior to analysis, leaving behind 93 subjects consisting 47 males and 46 females who completed the study. Table 1 shows the mean (SD), and the range of age, WC, BMI, SBP, DBP, TC, LDL-C, HDL-C, TG. Out of the 93 newly diagnosed diabetic patients, 62 (66.7%) were found to have metabolic syndrome. Among these 62 patients that have MetS, 26 (41.9%) were males and 36 (58.1%) were females (*P* < 0.019), indicating that the disease is more common in females and that it is statistically significant. Table 2 shows characteristic of patients stratified by WC as a measure of obesity and gender for those with MetS. Table 3shows different components of metabolic syndrome in type 2 diabetic patients stratified by gender. Hypertension is the most common factor; it was found in 80.6% (75): 37 males and 38 females (*P* = 0.635) while dyslipidemia and obesity were found in 61.3% (57) and 51.6% (48) respectively**.** Of the study subjects 33 had hypertension prior to the diagnosis of diabetes (DM). A total of 20 males had hypertriglyceridemia against 19 females *P* = 0.903. Equal number of males and females (19 each) had low HDL *P* = 0.931. Figure 1 shows metabolic syndrome and associated number of risk factors.

Discussion

Metabolic syndrome has received a lot of attention recently because of its importance as a health problem and because of different definitions created by several organizations such as, WHO,[4] IDF,[7] and NCEP-ATP III.[5] Type 2 diabetes mellitus, which accounts for 90% of all diabetes, has become one of the major causes of premature illness and death, mainly through the increased risk of cardiovascular disease (CVD)[20-24] and the addition of MetS further aggravates the situation.

We studied 93 newly diagnosed type-2 diabetes mellitus patients using NCEP-ATPIII[5] criteria. The study estimated a prevalence of 66.7%, which is very high. This is much higher than the rates obtained by Alebiosu and Odusan[25] who had a prevalence of 25.2%. Isezuo on the other hand had a prevalence of 54.3% in his study.[26] However it should be remembered that Alebiosu and Isezuo each had studied patients who had long standing diabetes unlike our study which studied newly diagnosed diabetes. Studies conducted in other parts of the world have prevalence rates of 70--80% among Caucasian type-2 diabetics.[18,27-29] Mansour[29] reported one of the highest prevalence rates of MetS which was 86% (82.7% of males and 94.5% of females) among type 2 diabetic patients in Basrah. Differences in the prevalence of the MetS may be largely due to differences in lifestyles, age of the study

Table 1: Characteristics of patients

Parameter	Mean (SD)	Range
Age (years)	55.27 (12.55)	24-84
SBP (mmHg)	153.52 (29.83)	100-230
DBP (mmHg)	94.23 (15.42)	60-140
TC (mmol/L)	5.17 (1.40)	2.0-11.12
HDL-C (mmol/L)	1.28 (0.48)	0.15-2.8
LDL-C (mmol/L)	2.06 (1.55)	0.1-9.40
TG (mmol/L)	1.75 (0.85)	0.5-5.0
WC men > 102 cm	101 (3.88)	85-108
Women > 88 cm	92 (6.77)	84-112
BMI kg/m^2	30.30 (6.23)	17.84-49.12

SBP = Systolic blood pressure, DBP = Diastolic blood pressure, TC = Total cholesterol, HDL-C = High density lipoprotein cholesterol, LDL-C = Low density lipoprotein cholesterol, TG = Triglycerides, BMI = Body mass index, BMI = Body mass index, WC = Waist Circumference, SD = Standard deviation. Data are mean (SD) and values of minimum and maximum parameters

Table 2: Characteristic of patients stratified by WC as a measure of obesity and gender

Parameter WC male > 102 cm female > 88 cm						
Total	Male with MetS	%	Total	Female with MetS	%	*P*-value
47	20	42.6	46	36	60.9	0.000

MetS = Metabolic syndrome, WC = Waist circumference. Data are number (%).

Table 3: Different components of metabolic syndrome in type 2 diabetic patients stratified by gender

Parameter	Total	Male with MetS	%	Total	Female with MetS	%	*P*-value
Hypertension	47	37	78.7	46	38	80.7	0.635
Dyslipidemia	47	29	61.7	46	28	60.9	0.934
Obesity	47	20	42.6	46	28	60.9	0.77

MetS = Metabolic syndrome;Data are number (%).

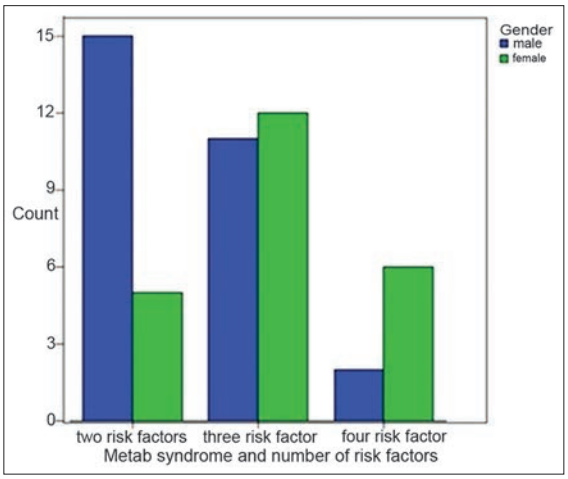

Figure 1: Number of risk factors and metabolic syndrome by sex

population, and the non application of uniform diagnostic criteria.[30]

Different studies report quite varied effects of gender on the metabolic syndrome in different populations. We observed that metabolic syndrome was more common in females with type-2 diabetes mellitus compared to their male counterparts (P value < 0.019). This higher percentage had earlier been reported in Nigerian women with type-2 diabetes mellitus.[31] In the USA, metabolic syndrome is more prevalent in white males than in females[28] but commoner in females among African-Americans and Mexican Americans. This sex difference in the prevalence of MetS is also found in Korea, Iran, India, Oman, Kinmen, and Japan where women were found to have a higher prevalence of the metabolic syndrome than men.[32-36] The gender difference in prevalence of MetS may be due to the higher prevalence of obesity in females than in males and also the relatively sedentary lifestyle of women, in this part of the world, due in part to cultural and social barriers. More importantly rapid urbanization and acquisition of western life style have resulted in decreased physical activity and increased calorie intake; two of the major contributors towards the development of diabetes and MetS.

Prevalence of the MetS tends to increase with age.[31,37] In this study we found that 72.5% were aged 50 years and above compared to 27.5% for those that were aged less than 50 years ($P < 0.014$). The reason for this may be due to the fact that advancing age affects all levels of pathogenesis which likely explains why the prevalence of MetS rises with advancing age. For example aging is associated with evolution of insulin resistance, other hormonal alterations, and increases in visceral adipose tissue[38] all of which are important in the pathogenesis of the MetS.

When we categorized our patients with metabolic syndrome into three groups according to the number of metabolic risk factors present, we found that the majority of patients were those who had three risk factors in addition to diabetes mellitus followed by those having two plus diabetes and lastly those with four risk factors in addition to diabetes. This trend is not similar to that found in the Nigerian diabetic population[26] The explanation could well be that Isezuo studied people with longstanding diabetes mellitus who may had various treatments unlike in our study in which the subjects were newly diagnosed and had not had any type of treatment.

The prevalence of different risk factors in patients of both sexes with MetS was studied. As all the patients had diabetes mellitus, males and females were compared for the presence of obesity, hypertension, and dyslipidemia (low HDL-C and high triglycerides levels). We found hypertension (74.5%) to be the most prevalent risk factor in both sexes followed by dyslipidemia (60.8%) and obesity (45.1%). This differed from the study of Ogbera who found the most common component to be central obesity[39] but is in keeping with the findings of Alebiosu and Odusan[25] in Nigeria and Akbar[28] in Saudi MetS patients with type 2 diabetes mellitus, where they reported hypertension as the most common component of the syndrome. Ogbera[39] had studied long-standing type 2 diabetes mellitus patients and this may have affected the

result. The prevalence of 74.5% for hypertension when compared to national average may appear high but when looked at in the context of hypertension in type 2 diabetes mellitus given as 10%-55%[40] it is not so high. The role of hypertension in exacerbating cardiovascular diseases is well documented in epidemiologic literature. Its ability to result in morbidity and mortality make this high prevalence rate worrisome especially in a population that is battling with infectious diseases, like ours. There was no statistical difference in the prevalence of hypertension between the sexes $P = 0.229$ as well as those with dyslipidemia $P = 0.572$. However, we found obesity more prevalent in females $P < 0.014$. Further more of those with dyslipidemia high triglyceride occurred more commonly than those with low HDL-C. HDL-C dyslipidemia occurred equally in both males and females while high triglyceride occurred more commonly in males than in females which was not statistically significant $P = 0.357$

Caution must however be exercised in interpreting these data especially when extrapolating it for the general population because of the small sample size. This limited study showed a very high prevalence MetS in T2DM population. There is need to conduct a study involving a larger population that would help in drawing recommendations for the primary and secondary prevention of this syndrome.

Conclusion

This study showed a very high prevalence of metabolic syndrome in newly diagnosed type 2 diabetes in Nigeria. Females were more affected than males. Treatment should be centered not only on blood sugar control but also on the other components of the metabolic syndrome.

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